Construction is shown in progress to expand the "tank farm" that supplied high-pressure air to the ramjet reactor, which was tested inside a special facility (lower left in the photo). In one experiment, Tory II-C (far right photo) required hundreds of tons of heated air to operate for nearly five minutes.

Flying and Terrestrial Nuclear Reactors

In 1955, the Laboratory and Los Alamos began work on Rover, a project intended to supply nuclear propulsion for space travel. The nuclear rocket program continued for many years at Los Alamos with many technical successes, while Livermore's attention shifted in 1957 to a new flying reactor effort, Project Pluto, for the Atomic Energy Commission and the Air Force. An awesome undertaking, Project Pluto entailed the design and testing of a nuclear ramjet engine for low-flying, supersonic cruise missiles that could stay aloft for many hours.

For Project Pluto, Livermore designed and built two Tory II-A test reactors to demonstrate feasibility, and Tory II-C was designed as a flight-engine prototype. Laboratory experts in chemistry and materials science were challenged to devise ceramic fuel elements that had the required neutronics properties for the reactor yet were structurally strong and resistant to moisture and oxidation at high temperatures. Because the reactors needed hundreds of thousands of the elements, they also had to be mass producible. Testing the reactors required novel remote-handling technologies, as well as systems capable of ramming about a ton of heated air through the reactor each second.

For 45 seconds on May 14, 1961, Livermore tested the Tory II-A at the Nevada Test Site. After additional successful experiments in 1961, Tory II-C was designed and built. Generating 500 megawatts of power (about half the power capacity of Hoover Dam), it was successfully tested in the spring of 1964. All six tests of the two Tory reactors were conducted without failure. However, that summer, the project was halted for lack of a firm military commitment.

Laboratory expertise in reactors and the nuclear fuel cycle has continued to find many applications. The year Project Pluto ended, Super Kukla began operation in a shielded bunker at the Nevada Test Site. Super Kukla was a prompt-burst neutron-pulse reactor designed to serve as a neutron source for irradiating a variety of test specimens, including fissile material used in weapon components. Experiments using the reactor helped to assure that U.S. nuclear warheads would function in wartime environments. In addition, from 1957 to 1980, the Livermore Pool-Type Reactor (a megawatt-class reactor) was operated onsite for neutron radiography, fundamental research on radiation damage to materials, and the detection of trace quantities of materials through neutron activation.

Today, Laboratory expertise in fission energy serves the Department of Energy, the Nuclear Regulatory Commission, and other government agencies through more than 80 projects. These efforts apply Livermore's advanced science and engineering capabilities to the protection of public health and safety and to the advancement of technology in fission energy and the nuclear fuel cycle (for example, the Yucca Mountain Project, discussed in Year 1980). Projects include technical support and services in areas such as risk and hazard analysis; structural and thermal analysis; containment, shielding, and criticality analysis; accident analysis; environmental assessments; radiation protection; and quality assurance.